A comparison of sample and total census data for a population of the Eastern Longneck Turtle *Chelodina longicollis* in a farm dam north-west of Sydney, New South Wales

Shelley Burgin,[1]* Steve Emerton[1] and Malcolm Burgin[1]

[1]Centre for Integrated Catchment Management, University of Western Sydney-Hawkesbury,
Richmond, New South Wales 2753
*Corresponding author

ABSTRACT

Interpretation of trap bias in sampling freshwater turtles has previously relied on indirect methods. The data presented here provides the first comparison of a sample and total census of a waterbody. Eastern Longneck Turtles *Chelodina longicollis* Shaw were sampled in a 0.1 ha farm dam for three days immediately prior to drainage and a population census was subsequently carried out. Fyke nets proved to be an effective method of sampling the population. During the sampling phase 78% of males (n = 11) and 81% of females (n = 21) were captured, and there was no significant difference between the sample and the census in terms of population size structure ($\chi^2_3 = 1.12$, excluding juveniles) or sex ratio ($\chi^2_1 = 0.008$). None of the three resident hatchlings were captured despite a high probability of capture (p = 0.67). Hatchlings and juveniles combined made up 19.4% of the population and there were no immature resident females and few immature males. Based on the population profile, recruitment was intermittent and apparently infrequent with the greatest cohort being mature females, although there were no immature females. Mature males were present in larger numbers than immature males.

Key words: *Chelodina longicollis*, Turtle, Farm dams, Sampling.

INTRODUCTION

Investigations of the population dynamics of freshwater turtles need to address trap bias since different capture methods yield different class size distributions and sex ratios (Ream and Ream 1966; Thompson 1983). Several methods have been reported for catching freshwater turtles in Australia including seine, fyke and gill netting, hand collection and muddling, i.e., foot sensing in the sediments (Chessman 1988a). Baited hoop traps, often modified after Legler (1960), are commonly used (e.g., Chessman 1984, 1988a,b; Georges *et al.* 1986; Kennett and Georges 1990) and have yielded samples of *Emydura kreftii* [Gray] (Fraser Island) that are unbiased with respect to size distribution and sex ratios (Georges *et al.* 1993). The potential for biased population data for other species, such as the Eastern Longneck Turtle *Chelodina longicollis* Shaw, needs to be addressed.

Since hoop nets need to be cleared and reset at intervals of between 1 and 3 hours (Chessman 1988b; Kennett and Georges 1990), the mechanical movement required to clear the nets could adversely affect turtle trapping success. Turtles also have the ability to move out of hoop traps after capture, and thus we considered this approach to sampling turtles to be sub-optimal. Few turtles were caught when seine netting and muddling, compared to fyke netting (pers. obs.), although Parmenter (pers. comm.) was satisfied with the numbers that he has obtained by seine netting. Beumer *et al.* (1981) incidentally caught *C. longicollis* in fyke nets in all but two months of his two year study (August 1975 and June 1976), and Houston (pers. comm.) regularly captured turtles in fyke nets during his study of the Arafurian File Snake *Acrochordus arafurae* McDowell in the Northern Territory. As a result of these observations, we use fyke nets to sample freshwater turtles and in this study we investigated their effectiveness for sampling a population of *C. longicollis* in the Sydney Region.

One way to address problems of sample bias, due to netting, is to follow routine sampling with a total census. In this way the sample can be compared with the total population. A rare opportunity to do this occurred when we were notified that a dam in western Sydney was to be filled in for a housing estate development. The dam was typical of thousands that are found throughout peri-urban and rural properties across Australia, but even if it were typical only of peri-urban Sydney, it would still be a useful study because these dams are being in-filled in their hundreds, without attention to the impact on turtles or other fauna dependent upon them.

MATERIALS AND METHODS

Study site

The dam was located on an abandoned market garden at Quakers Hill (35 km north-west of Sydney). Evidence from a 1974 orthophotographic map (1:25 000 Central Mapping Authority, Riverstone 9030-I-S, 1974) indicated that it had existed for at least 20 years. Its unvegetated banks had a slope of approximately 30°. Its surface area was about 0.1 ha (37 m × 27 m). The dam was blanketed with duckweed *Lemna minor* [L.] and had an average depth of 1.8 m. The substratum consisted of fine silt over a clay base.

Pre-drainage sampling

The study was undertaken during typical Sydney summer weather conditions: dry and sunny. For the three days prior to the commencement of drainage, eight fyke nets were set overnight in the shallows against the dam's perimeter. Thereafter, nets were set and adjusted to coincide with the receding water levels until too little water remained to effectively set the nets. The nets were emptied each morning and turtles were weighed, measured (straight line carapace length, breadth and height of animal in mm), sexed (after Kennett and Georges 1990) and uniquely marked (after Parmenter 1976). Samples from the first two mornings were released at the point of capture but were not returned to the draining dam on the third morning.

Total census sampling

Nets continued to be set at the water's edge and the captured animals removed, while sufficient water remained to set the nets. In addition, the banks of the dam and surrounding land were regularly searched (approximately 80 person-hours) for animals. Approximately four hours after drainage began, a band of silt around the perimeter was exposed, allowing for an accurate account of animals leaving the dam through observation of distinctive turtle tracks in the silt.

A diesel powered pump with an estimated flow rate of 80 kL/h was used to drain the dam between 0730 and 1630 hours from the 13 to 16 March, 1995. Two days after drainage was completed, approximately 50 cm depth of sludge was removed using an excavator with a bucket capacity of 0.5 cubic metre. A tip truck distributed the silt in strips on adjacent flat land where it settled to a height of approximately 45 cm. The entire process was continuously monitored for signs of turtle activity until 23 March.

Comparison between sample and census

To compare size range between the sampled population and the total population, a chi^2 analysis was undertaken on size (carapace length) and sex ratio with Yates' correction for continuity as appropriate (Zar 1984). Because of the small number of hatchlings, they were excluded from the analysis. Post-hatchling individuals were arbitrarily divided into small and large males (small <135, large >140 mm) and females (small <195, large >225 mm).

RESULTS

Thirty-seven *C. longicollis* were captured and marked during the study period: 13 males, 21 females and three small hatchlings. Twenty-seven of these were captured in the three days of sampling before the dam was drained. A total of 36 turtles were accounted for in the total census: 15 not released after the third day of sampling; 16 netted as the water receded and five sets of outward bound tracks in the silt (Table 1; Fig. 1).

Thirty-five per cent of the turtle population was captured on the first day, 40% by the end of the second day and 73% had been sampled by day three when the draining of the dam commenced.

The density of turtles in the dam was calculated at 360 ha^{-1}. During the sampling phase of the study no hatchlings were caught but 78% of males (n = 11 and 81% (n = 21) of females were captured. The sample did not differ significantly from the population, either in terms of sex ratio ($\chi^2_1 = 0.008$) or size structure ($\chi^2_3 = 1.12$, excluding juveniles). The probability of capturing a hatchling during the three days of sampling was calculated to be p = 0.67.

DISCUSSION

The concept of this study was to compare trapped turtles with a total census. Such data have previously not been collected for any turtle species. In an ideal world this would have involved replication, both in other farm dams and natural waterbodies. However, it was no small task to organize the drainage of the dam to ensure a total census and this had not been achieved before. We therefore had the rare opportunity to study one dam's freshwater turtle population, before and after draining. Sampling began within two hours of hearing that the dam was to be drained, after contact and support had been gained from both the dam's owners and the contractors. We have provided one data set. Replication will have to await the opportunity arising again.

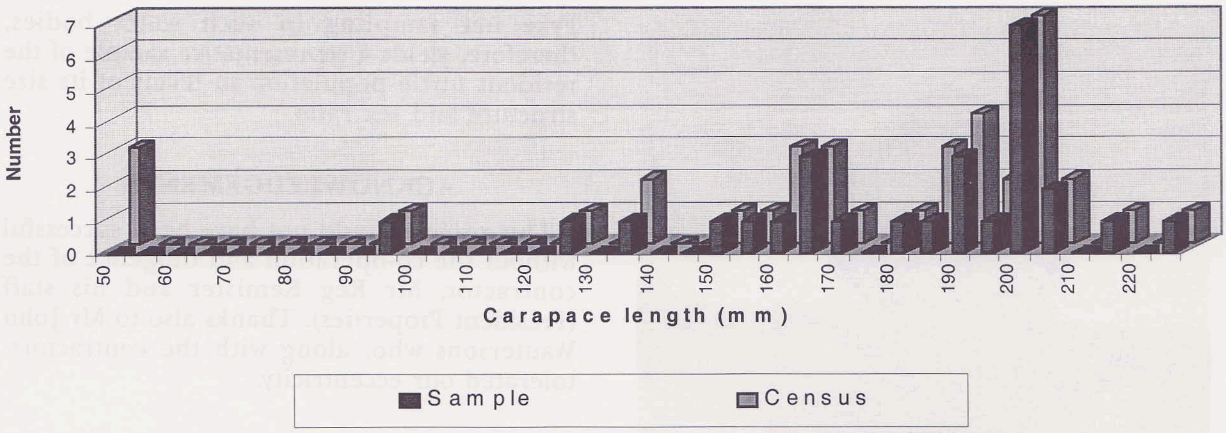

Fig. 1. Size class distribution of turtles sampled from a farm dam compared with a total census. Animals between 95–170 mm were male, all larger animals were adult females.

Table 1. Summary data of sampled population and total census of *Chelodina longicollis* from a dam in Quakers Hill (Sydney), March 1995.

Parameter	Population sample (n = 27)	Total population (n = 37)
body mass	125–1040 (x̄ 650, sd 245)	5–1040 (x̄ 567, sd 291)
carapace length	92.7–222.6 (x̄ 177, sd 30)	31–222.6 (x̄ 162.5, sd 49)
carapace breadth	74.7–155.5 (x̄ 130, sd 20)	26.3–159.3 (x̄ 119.4, sd 34)
body thickness	32.6–64.6 (x̄ 55. sd 8)	13.3–64.6 (x̄ 51.3, sd 14)
sex ratio	10 males : 17 females	13 males : 21 females

Burbridge (1967) reported that no data were available on any population of Australian Chelidae. Since that time a number of authors have assumed, based largely on intuition, that various techniques discriminate against the capture of juveniles (e.g., Parmenter 1976; Chessman 1978). Others have compared captures with re-captured individuals to assess trapping bias (e.g., Georges 1982; Dalem 1998). Our study provided a unique opportunity to obtain an understanding of the freshwater turtle population structure of a dam and compare it with a typical sampling approach. The comparison showed that the sample provided a good estimate of the sex ratio and size of individuals resident in the dam, and it was therefore concluded that fyke nets provided a reasonable sample.

Wong and Burgin (1997) suggested that population structure was dependent upon the recruitment pattern. Georges (1985; Georges *et al.* 1993) postulated that this could occur as a "sustained trickle" of young, recruited annually, and this would result in equal numbers of juveniles and adults in the population. Alternatively, recruitment may be intermittent. This would result in a relatively large number of particular age cohorts being predominant. The data presented here indicated that recruitment was intermittent.

Male *C. longicollis* mature at approximately seven years and females at 10–11 years of age. Females usually lay one clutch of eggs annually (Parmenter 1985) of between 6 and 23 eggs (Legler 1985). Without mortality, recruitment to the population would be between 126 and 483 hatchling/year or a standing stock in the dam of 630–2 730 juvenile and sub-adult females and 441–4 641 males. Although large numbers of nests are destroyed annually (Thompson 1983), it is widely accepted that predation is most intense on the smaller cohorts. Previous researchers have assumed that their capture techniques have under estimated juvenile numbers (e.g., Parmenter 1976; Chessman 1978; Thompson 1983). Evidence to support this hypothesis is provided by a comparison of catch against number of animals caught (e.g., Georges 1982; Dalem 1998), although this approach does not address preferential predation on smaller individuals. The data presented here were the first to provide a true picture of the structure of a resident population. Hatchlings and juveniles combined made

Author (Shelley Burgin) with an Eastern Longnecked Turtle *Chelodina longicollis*.

up 19.4% of the population and were not, as intuitively expected, present in large numbers.

There was no significant difference between the sample and the population structure in terms of sex ratio or size structure (excluding hatchlings). The distribution was skewed towards mature females (i.e., >170 mm, Parmenter 1985). No immature females were present and mature males (<150 mm, Parmenter 1985) were present in greater numbers than immature males and hatchlings but in smaller numbers than mature females. The observed turtle density of 360 ha^{-1} falls within the range estimated for other farm dams studied (236 ha^{-1}, Chessman 1978 to 400 ha^{-1}, Parmenter 1976).

CONCLUSION

These data provide evidence (not just an estimate) that there are substantial numbers of turtles resident in farm dams. Albeit limited data, the density of turtles was at the upper end of the range of estimates of standing stock of turtles in farm dams from elsewhere. Fyke net sampling in such water bodies, therefore, yields a representative sample of the resident turtle population in terms of its size structure and sex ratio.

ACKNOWLEDGEMENTS

This project would not have been successful without the co-operation and diligence of the contractor, Mr Reg Kemister and his staff (President Properties). Thanks also to Mr John Wautersons who, along with the contractors, tolerated our eccentricity.

REFERENCES

Beumer, J. P., Burbury, M. E. and Harrington, D. J., 1981. The capture of fauna other than fishes in eel and mesh nets. *Aust. Wildl. Res.* **8:** 673–77.

Burbridge, A. A., 1967. The biology of southwestern Australian tortoises. Ph.D. thesis, University of Western Australia: Perth.

Chessman, B. C., 1978. Ecological studies of freshwater turtles in south-eastern Australia. Ph.D. thesis. Monash University: Melbourne.

Chessman, B. C., 1984. Food of the Snake Necked Turtle, *Chelodina longicollis* (Shaw) Testudines: Chelidae) in the Murray Valley, Victoria and New South Wales. *Aust. Wildl. Res.* **11:** 573–78.

Chessman, B. C., 1988a. Habitat preferences of freshwater turtles in the Murray Valley, Victoria and New South Wales. *Aust. Wildl. Res.* **15:** 485–91.

Chessman B. C., 1988b. Seasonal and diel activity of freshwater turtles in the Murray Valley, Victoria and NSW. *Aust. Wildl. Res.* **15:** 267–76.

Dalem, A. A. G. R., 1998. Demography and movement patterns of a population of Eastern snake-necked turtles, *Chelodina longicollis* (Shaw, 1794). M.Sc. thesis, University of Western Sydney-Hawkesbury: Richmond.

Georges, A., 1982 Ecological studies of Krefft's river tortoise, *Emydura krefftii* (Gray), from Frazer Island, Queensland. Ph.D. thesis, University of Queensland: Brisbane.

Georges, A., 1985. Reproduction and reduced body size of reptiles in unproductive environments. Pp. 311–18 in *Biology of Australasian Frogs and Reptiles* ed by G. Grigg, R. Shine and H. Ehmann. Surrey Beatty & Sons: Chipping Norton.

Georges, A., Norris, R. H. and Wensing, L., 1986. Diet of the Freshwater turtle *Chelodina longicollis* (Testudines: Chelidae) from the Coastal Dune Lakes of the Jervis Bay Territory. *Aust. Wildl. Res.* **13:** 301–08.

Georges, A., Limpus, C. J. and Parmenter, C. J., 1993. Natural history of the *Chelonia*. Pp. 120–28 in *Fauna of Australia Vol. 2A: Amphibia and Reptilia* ed by C. J. Glasby, G. J. B. Ross and P. L. Beesley. Australian Government Publishing Service: Canberra.

Kennett, R. M. and Georges, A., 1990. Habitat utilisation and its relationship to growth and reproduction of the eastern long necked turtle, *Chelodina longicollis* (Testudinata: Chelidae) from Australia. *Herpetologica* **46**(1): 22–33.

Legler, J. M., 1960. A simple and inexpensive devise for trapping aquatic turtles. *Proc. Utah Acad. Sc.* **37:** 63–66.

Legler, J. M., 1985. Australian chelid turtles: reproductive patterns in wide-ranging taxa. Pp. 117–23 in *Biology of Australasian Frogs and Reptiles* ed by G. Grigg, R. Shine and H. Ehmann. Surrey Beatty & Sons: Chipping Norton.

Parmenter, C. J., 1976. The natural history of the Australian freshwater turtle, *Chelodina longicollis*. Ph.D. thesis, University of New England: Armadale.

Parmenter, C. J., 1985. Reproduction and survivorship of *Chelodina longicollis* (Testudinata: Chelidae). Pp. 53–61 in *Biology of Australasian Frogs and Reptiles* ed by G. Grigg, R. Shine and H. Ehmann. Surrey Beatty & Sons: Chipping Norton.

Ream, C. and Ream, R., 1966. The influence of sampling methods on the estimation of population structure in painted turtles. *Amer. Midl. J.* 325–28.

Thompson, M. B., 1983. Population of the Murray River Tortoise, *Emydura* (Chelodina): the effect of egg predation by the red fox, *Vulpes vulpes*. *Aust. Wild. Res.* **10:** 363–71.

Wong, P. and Burgin, S., 1997. Preliminary observations of the freshwater turtle, *Chelodina longicollis* (Shaw), in the Longneck Lagoon Catchment (Hawkesbury-Nepean River, New South Wales). *Herpetofauna* **27**(2): 13–16.

Zar, J. H., 1984. Biostatistical analysis, second edition. Prentice-Hall International: New Jersey.

Book Reviews — Book Reviews

Nature Photography by Ken Griffiths.
UNSW Press.
RRP $29.95.

All of us have had that feeling when we are standing out of doors, a camera in hand, and we have a particular image that we want to capture on film. With limited experience and often inappropriate equipment we do the best we can. Often we can be a little disappointed at the result. If you have ever tried to creep-up on wildlife and capture the perfect close-up, feeling like Dombrovskis or Parish, only to look through the camera lens and be surprised at how small the subject still seems, then this book is for you.

In the last 20 years wildlife photography has gone from being the hobby of a few dedicated solo eccentrics to being accessible to almost anybody who enjoys spending extended periods outdoors.

Ken Griffiths knows his craft. In studying this book you get the feeling you are being guided by an old master. This is not somebody who has hauled large format equipment and exorbitantly expensive accessories into the bush. Nor is he a single camera make exponent, a "Nikon-man" or "Canon-man". This is somebody who has developed an interest in photography and grown with that interest over the years.

His book has patiently laid out the steps to take to get that bit extra out of your developing interest without having to apply for an overdraft or trade-in your current equipment for the latest offerings from the camera shop. Griffiths points out that you can use the more modern "auto-everything" equipment but the limitations become apparent if you get serious in your approach to this subject. His equipment has the patina of many years of faithful service with the brass-metal camera bodies showing through their shiny black coatings. The results from these older cameras certainly speak for themselves as the book is liberally padded with many fine examples of his work and the methods of how they were achieved.

The book is light and compact so you could conceivably carry it around with you for a quick reference while actually out photographing a subject.

As with any book there is a few minor problems. The term "nowadays" appears a little too often within the text for my comfort, very much reinforcing his "old school" approach to the subject. The use of colour highlighting in the text for quick reference does not always work due to the pale nature of the colours chosen. The caption format for his photos is not always standardized with the result that sometimes the main text appears to flow into a photo caption. With some pictures the subject is without identification, a detail that would not detract from the intended example. Finally a couple of his photographic examples are a little obscure as to the technical point they are trying to represent.

It was a little disappointing that the section on ethics did not include the warning on the possibility of predation of the subject, particularly involving nestlings, when disturbing wildlife during photography.

Overall the book is an excellent example of taking some of the mystery out of photography. For any budding photographer, young or old alike, there is much to benefit by the reading of this very accessible book.

Nicholas Carlile
Biodiversity Survey and Research Division
NPWS